

HIGH-CAPACITY TRANSIT STUDY

CENTRAL AND EAST CORRIDORS

SEPTEMBER 2014

CORRIDOR REPORT:
BALLARD-UNIVERSITY DISTRICT

HIGH-CAPACITY TRANSIT CORRIDOR STUDY
Ballard to University District Corridor

**Sound Transit Central/East
High-Capacity Transit Corridor Study**

**Corridor Report:
Ballard to University District**



September 2014



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Acronyms and Abbreviations

BRT	bus rapid transit
BUD	Ballard to University District
Central/East HCT Corridor Study	Central/East High-Capacity Transit (HCT) Corridor Study
CTR	Commute Trip Reduction
ERC	Eastside Rail Corridor
ETC	Elevated Transportation Company
HCT	high-capacity transit
I-405	Interstate 405
I-5	Interstate 5
I-90	Interstate 90
KBI	Kirkland-Bellevue-Issaquah
LRT	light rail transit
PSRC	Puget Sound Regional Council
SR	State Route
TMP	<i>Transit Master Plan for the City of Seattle</i>
TOD	transit-oriented development
UKR	University District-Kirkland-Redmond
WSDOT	Washington State Department of Transportation

EXECUTIVE SUMMARY

The Central/East High-Capacity Transit (HCT) Corridor Study (HCT Corridor Study) is one of five HCT corridor planning studies Sound Transit has conducted to accomplish the following: 1) support the Sound Transit Board of Directors in decisions about the Sound Transit Long-Range Plan update and 2) inform choices for the next phase of the regional HCT system plan's development. The study area for the HCT Corridor Study spans from Lynnwood at the north to Renton at the south, from Ballard at the west and Issaquah at the east. This study area encompasses major sections of Interstate 405 (I-405) and portions of State Route (SR) 520 and Interstate 90 (I-90), which are the primary routes serving the cities inside the study area. The study explored opportunities for improving transit connections within the following five corridors:

- University District-Kirkland-Redmond
- Ballard to University District
- Eastside Rail Corridor
- I-405 Bus Rapid Transit
- Kirkland-Bellevue-Issaquah

This report summarizes the process used to identify and evaluate high-capacity transit (HCT) system improvements specifically for the Ballard to University District Corridor. The Ballard to University District Corridor is a dense, urban 5-mile east-west running corridor between two population and employment centers in Seattle. Despite narrow roadways and high levels of traffic congestion, the corridor is characterized by heavy transit use. Significant population and employment growth is projected for the corridor. HCT improvements could play a key role in serving anticipated ridership increases and connecting the Ballard to University District Corridor to the existing and planned regional transit network.

East-west trips in this corridor, including a substantial number of transit trips, occur in highly constrained rights-of-way. Serving the forecasted transit demand with HCT will be difficult without substantial improvements that allow transit to operate more efficiently. At the same time, dense development and topography limit the number of options available to accommodate those improvements.

Another HCT corridor study, Ballard to Downtown Seattle, has examined potential light rail or rapid streetcar options that could connect Ballard to Downtown Seattle. At the east end of the corridor, the U-District Station is under construction as part of North Link Extension, which will connect the University District with the regional light rail system. Should the Ballard to Downtown Seattle connection advance, the corridor options evaluated in this report could connect to this segment.

In September 2013, Sound Transit completed a report that documented the existing and forecasted future land use, transportation, environmental, and transit service conditions within the Ballard to University District Corridor. This report (Sound Transit, 2013) included a problem

statement that summarized the needs in this corridor that could be served by HCT service. The report and problem statement were used as a basis for the development of a list of corridor options (14) to be considered by Sound Transit. Each concept connected Ballard to the University District via light rail transit or bus rapid transit and included at-grade with tunnel and elevated elements where topography or other engineering-related constraints existed. All 14 options were examined against the project's purpose statement to discern which options best meet the transit needs in the corridor. A total of 10 representative alternatives were advanced into the Level 1 Evaluation following a workshop in October 2013.

For the Level 1 Evaluation, the ten alternatives were compared against one another in relation to 15 performance measures, all related to Sound Transit's Long-Range Plan goals. More detailed information about the Level 1 Evaluation is available in the *Ballard to University Corridor Level 1 Evaluation Report* (Sound Transit, 2014a). A workshop held in January 2014 advanced six representative alternatives into a more robust Level 2 Evaluation.




















The Level 2 Evaluation relied on a more detailed conceptual design of the representative alternatives and robust evaluation against a set of 16 performance measures. These Level 2 Evaluation alternatives are illustrated in Exhibit ES-1. The key findings of the Level 2 Evaluation are provided below and summarized in Exhibit ES-2; more detailed information is available in the *Ballard to University District Corridor Level 2 Evaluation Report* (Sound Transit, 2014b):

- **Ridership:** All of the alternatives in the Ballard to University District corridor show high potential ridership. However, variations among the alternatives are apparent, with light rail transit (LRT) alternatives carrying 20,000 to 28,000 riders per day and bus rapid transit (BRT) alternatives carrying 10,000 to 17,000 riders per day.
- **Travel Time and Reliability.** Given the density of land uses and high traffic congestion levels in the area, variations in travel time are largely a function of the amount of dedicated runningway. The at-grade BRT alternatives that operate in mixed traffic are slower and less reliable than elevated, tunnel, or at-grade alternatives with more exclusive runningway.
- **Conceptual Design Cost Estimate:** High performance on the travel time and ridership measures is accompanied by higher cost. As noted above, costs are fairly comparable among the LRT alternatives, ranging from \$1,163 million to \$1,879 million, with nearly half the cost of surface LRT alternatives resulting from potential right-of-way acquisition. In general, LRT costs are approximately three to five times those of the BRT alternatives, which range from \$159 million to \$387 million.
- **Right-of-Way Effects:** All surface alternatives have high levels of potential right-of-way impacts associated with replacing lanes and/or parking displaced by dedicated guideway. The LRT tunnel and elevated LRT alternatives have lower right-way effects but are substantially more expensive. Overall, the LRT tunnel alternative has the highest cost, although right-of-way acquisition costs and property impacts are lower than the surface LRT and exclusive BRT options.

- **Cost Effectiveness:** Since ridership is strong in the Ballard to University District Corridor, cost effectiveness is relatively high for all alternatives.

Overall the main differentiators within the Ballard to University District Corridor were reliability (those alternatives operating in exclusive right-of-way versus mixed traffic), ridership (in this constrained corridor a factor of whether the alternative provided reliable travel times), and cost (LRT alternatives had higher construction costs than BRT alternatives and tunnels had higher construction costs than surface or elevated alternatives). In general, however, all alternatives achieved relatively high ridership numbers and were comparatively cost-effective.

Exhibit ES-2: Evaluation Summary for BUD Corridor Alternative

				 U District - Wallingford - Ballard		 U District - Fremont - Ballard		 U District - Wallingford - Fremont - Ballard	
GOAL	PERFORMANCE MEASURES								
Provide a transportation system that facilitates long-term mobility	 Travel Market Potential	 BRT in a combination of mixed traffic and exclusive busway along N 50th St	 LRT via Wallingford tunnel	 LRT via N Pacific St and Leary Wy NW	 LRT with elevated segments through University District and Fremont	 BRT in mixed traffic and exclusive busway along N Pacific St and Leary Wy NW	 LRT via N 45th St, Stone Wy N, and Leary Wy NW		
	 Reliability	18 to 22 minutes 14k to 17k riders per day	6 to 9 minutes 22k to 26k riders per day	10 to 13 minutes 20k to 24k riders per day	10 to 12 minutes 21k to 26k riders per day	14 to 19 minutes 10k to 12k riders per day	9 to 11 minutes 23k to 28k riders per day		
Enhance communities and protect the environment	 Environmental Effects								
	 Existing Transportation System								
Contribute to the region's economic viability	 Development Potential								
Strengthen communities' access to and use of the regional transit network	 Regional Connectivity								
Develop a system that is financially feasible	 Preliminary Design Cost Estimate	\$159 mil - \$206 mil	\$1,396 mil - \$1,879 mil	\$1,215 mil - \$1,641 mil	\$1,163 mil - \$1,572 mil	\$286 mil - \$387 mil	\$1,238 mil - \$1,672 mil		
	 Complexity								
	 Cost Effectiveness								

1 INTRODUCTION

The Central/East High-Capacity Transit (HCT) Corridor Study (HCT Corridor Study) is one of five HCT corridor planning studies Sound Transit has conducted to accomplish the following: 1) support the Sound Transit Board of Directors in decisions about the Sound Transit Long-Range Plan update and 2) inform choices for the next phase of the regional HCT system plan's development. The study area for the HCT Corridor Study (Exhibit 1) spans from Lynnwood at the north to Renton at the south, from Ballard at the west and Issaquah at the east. This study area encompasses major sections of Interstate 405 (I-405) and portions of State Route (SR) 520 and Interstate 90 (I-90), which are the primary routes serving the cities inside the study area. The study explored opportunities for improving transit connections within the following five corridors:

- University District-Kirkland-Redmond
- Ballard to University District
- Eastside Rail Corridor
- I-405 Bus Rapid Transit
- Kirkland-Bellevue-Issaquah

This report summarizes the process used to identify and evaluate HCT system improvements specifically for the Ballard to University District Corridor, and key findings from that evaluation. This Ballard to University District Corridor report evaluates alternatives with the potential to improve regional transit connections between Ballard and the University District, with service to Wallingford and/or Fremont, and it also measures the performance of these improvements, such as ridership and mobility benefits, environmental impacts and benefits, transit costs and cost-effectiveness, and consistency with regional and local plans. Similar documents have been prepared for the four other corridors included in the list above, as well as other corridors within Seattle (Ballard to Downtown, Downtown to West Seattle), to the north (Lynnwood to Everett), and to the south (vicinity of Burien, SeaTac, and Tukwila and Federal Way to Tacoma). The study results will help inform the ST Board as they work to update the agency's Long-Range Plan and as they make future decisions regarding mode, alternative and implementation of HCT.

2 PROBLEM STATEMENT

The Ballard to University District corridor is a dense, urban 5-mile east-west running corridor between two population and employment centers in Seattle. Despite narrow roadways and high levels of traffic congestion, the corridor is characterized by heavy transit use. Significant population and employment growth is projected for the corridor. HCT improvements could play a key role in serving anticipated ridership increases and connecting the corridor to the existing and planned regional transit network.

Exhibit 1. Sound Transit HCT Studies



The corridor includes several north-south highways, including Interstate 5 (I-5) and SR 99, but no east-west highways. All of the major east-west arterials experience substantial congestion during peak periods, resulting in slow and unreliable travel between the corridor's urban and regional centers. In addition, a series of drawbridges in the area open frequently throughout the day, creating additional east-west and north-south congestion. All of these congestion and reliability issues are expected to worsen with future growth in the corridor, and with the exception of the Montlake Bridge there are no current plans for expanding capacity on those facilities.

Today, transit is already well-utilized in the corridor. King County Metro provides 6,660 daily transit trips between Ballard and the University District, and transit demand for this market is projected to increase by almost 50 percent between now and 2035. The University of Washington, which enrolls more than 40,000 students a year and includes over 40,000 employees, brings people from the entire region to the University District. Within the Seattle transit market, Ballard accounts for approximately 17 percent of the total transit users going to and from the University District.

At the west end of the corridor, a light rail or rapid streetcar system has been examined in a similar HCT study that could connect Ballard to Downtown Seattle. At the east end of the corridor, the U-District Station is under construction as part of the North Link project, which will connect the University District with the regional light rail system. Should the Ballard to Downtown connection be built, a link between Ballard and the University District would connect these two HCT systems.

Ballard and the University District are both identified as “urban villages” – areas of concentrated population and housing growth – in the Seattle Comprehensive plan. Other urban villages near the corridor include Crown Hill, Greenwood/Phinney Ridge, Fremont, and Wallingford. HCT in this corridor could be a key link among these areas of focused growth.

The area is dense, with extensive urban, residential and commercial development. The major physical constraints to future HCT development include the steep topography of Phinney Ridge between Ballard and Wallingford, and park resources around Green Lake and Woodland Park. Trips between Ballard and the University District are highly constrained along the major west-east arterials today.

In summary, east/west trips in this corridor – including a regionally significant number of transit trips – occur in highly constrained rights of way. Serving the forecasted transit demand will be difficult without substantial improvements that allow transit to operate more efficiently. At the same time, dense development and topography present challenges for the number of options available to accommodate those improvements.

3 BACKGROUND

This section summarizes the previous analysis completed for the Ballard to University District Corridor and a summary of the baseline condition assessment, including highlights from the corridor's travel market assessment.

3.1 Previous Analysis

The following local and regional plans included previous evaluation of transit improvements in the Ballard to University District Corridor.

3.1.1 Seattle Popular Transit Plan (Seattle Monorail Project)/Environmental Impact Statement

In November 1997, Initiative 41 was passed by Seattle voters, creating the Elevated Transportation Company (ETC) to study the possibility of building a 40-mile monorail system in Seattle. Initiative 53, passed in 2000, provided funding to ETC to create a plan for building a monorail system. This included a 14-mile extension from Ballard through Downtown Seattle to West Seattle. Various alternatives for this corridor were studied in an environmental impact statement (ETC, 2002). In 2005, another vote (Proposition 1) resulted in a decision to end the monorail project. The Seattle Monorail Authority was dissolved in 2008.

3.1.2 Sound Transit Long Range Plan

The Sound Transit Board adopted an updated long-range plan in July 2005, known as *Regional Transit Long-Range Plan* (Sound Transit, 2005). This plan represents Sound Transit's goals, policies, and strategies to guide the long-term development of the HCT system. It also serves to guide how the Sound Transit system can best address the region's mobility needs and support growth management objectives, and it is intended to be implemented in a series of phases. This plan includes a potential rail corridor between Downtown Seattle, Ballard, and the University District.

3.1.3 Sound Transit 2 Plan

Sound Transit's *Sound Transit 2 Plan* (Sound Transit, 2008) is a package of transportation improvements for funding and implementation that extends the regional transit network. The *Sound Transit 2 Plan* was approved by voters in November 2008, and it includes funding for planning studies to evaluate potential future HCT transit expansion. The corridor between Ballard and the University of Washington is identified for study to evaluate and examine options for potential expansion of the regional transit system beyond the *Sound Transit 2 Plan*.

3.1.4 Transportation 2040

Transportation 2040 (Puget Sound Regional Council [PSRC], 2010a) is PSRC's regional transportation plan adopted in 2010 that considers the actions necessary for the region to meet

its long-term mobility needs, given the future land use policy and growth management strategy assumptions established in *Vision 2040* (PSRC, 2009). *Transportation 2040* considers different types of transportation investments to improve system efficiency and/or expand system capacity while supporting regional goals for growth management and environmental protection. Investment and management strategies include tolling, targeted roadway expansion, transit service improvements, carpool programs, high-occupancy vehicle lanes, and bicycle and pedestrian improvements. *Transportation 2040* includes potential HCT between the University District and Ballard.

3.1.5 City of Seattle Transit Master Plan

The *Transit Master Plan for the City of Seattle* (TMP; City of Seattle, 2012) was adopted in 2012. It provides a vision for a network of transit corridors that connect the city's urban centers and villages with high-quality transit service within a short walk for most residents. As part of this vision, the TMP includes future HCT between Ballard and the University District with service to Wallingford. This corridor is known in the TMP as Corridor 13. The TMP calls for bus service in this corridor.

During development of the TMP, 15 priority bus corridors were evaluated, including Corridor 13. Corridor 13 scored ninth out of the 15 corridors analyzed, but it was noted that this corridor scored higher with an extension to Laurelhurst. Following are improvements and actions identified for implementation by the TMP at an undefined future time for Corridor 13:

- Implement existing planned improvements (for example, bus bulbs, traffic signal priority, bus lanes) on NW Market Street/NW 45th Street and Roosevelt Way NE/11th Avenue NE couplet
- Verify turnaround options on west end and alternative options on east end, including after Link light rail opens and to avoid duplication with the Crown Hill-Green Lake-University District Corridor.

3.2 Travel Markets

The travel market and usage information is based on output from the Sound Transit Ridership Forecasting Model (Sound Transit, 2013), Washington State Department of Transportation's (WSDOT's) commute trip reduction (CTR) survey (WSDOT, 2012), and a regional data collection of cell phone data (AirSage, 2013). The CTR survey data are limited to individuals who work for large employers (more than 100 employees), but they are helpful in understanding the market potential for employment centers. The share of total daily trips was collected via cell phone data collection techniques and was cross-checked against the PSRC's Regional Travel Demand Forecast Model (PSRC, 2010b) and household survey to test for reasonableness. As cell phone users traverse the region, their phones are constantly checking in with cell phone towers to check for new data and to establish location. These checks can be tied to specific cell phone towers and provide a data point for a location of the cell phone at various points in time. These

time points can establish overall trip making patterns without distinguishing any specifics about mode of access or trip purpose.

3.2.1 Ballard Travel Markets

Table 1 shows the distribution of total daily trips and transit trips for the Ballard travel market forecasted to 2035. Forecasts include RapidRide and the South Lake Union Streetcar. The largest travel markets for transit users by far are within the city of Seattle, with a total share of approximately 90 percent. Of the transit trips going to Seattle, 25 percent are going to and from the Seattle Central Business District, 12 percent to and from the University District, and another 40 percent going to other places within the city, many of which are neighborhoods in the northwest part of Seattle. The transit market outside Seattle is much smaller with the city of Bellevue, accounting for just over 5 percent of the Ballard transit market.

Table 1. Future Year Travel Markets for Trips to and From Ballard

Major Market by Districts		Transit Trips		Commute Trips		Total Daily Trips	
		Daily Trips	Share	Daily Trips	Share	Daily Trips	Share
North	North Snohomish County	580	1%	1,000	2%	1,400	0%
	South Snohomish County	1,160	2%	4,800	12%	8,200	3%
South	Burien	80	0%	400	1%	800	0%
	Tukwila and Renton	780	1%	1000	2%	1,800	1%
	SeaTac and Des Moines	500	1%	200	0%	2,200	1%
	Federal Way	90	0%	400	1%	400	0%
	Kent	150	0%	600	1%	800	0%
East	Far East King County	570	1%	1000	2%	1,200	0%
	Redmond (Downtown)	160	0%	0	0%	400	0%
	Redmond (Overlake)	440	1%	0	0%	800	0%
	Issaquah	420	1%	0	0%	200	0%
	Kirkland, Bothell, Woodinville and Kenmore	620	1%	800	2%	1,200	0%
	East Bellevue	1,030	2%	400	1%	1,800	1%
	West Bellevue and Mercer Island	1,620	3%	400	1%	2,000	1%
Central	Seattle Central Business District	15,610	25%	4,600	11%	60,400	20%
	Ballard, Fremont, and Wallingford	6,380	10%	11800	29%	138,400	46%
	University Community	7,390	12%	400	1%	10,800	4%
	Rest of Seattle	23,370	38%	11,800	29%	66,600	22%

Table 1. Future Year Travel Markets for Trips to and From Ballard

Major Market by Districts		Transit Trips		Commute Trips		Total Daily Trips	
		Daily Trips	Share	Daily Trips	Share	Daily Trips	Share
Region	Pierce County	280	0%	1200	3%	2,200	1%
	Rest of Region	430	1%	400	1%	400	0%
Total		61,660	100%	41,200	100%	302,000	100%

3.2.2 University District Travel Markets

Table 2 shows the distribution of total daily trips and transit trips for the University District forecasted to 2035. More than 70 percent of transit users in the University District travel to or from the city of Seattle. The two other large transit markets for the University District are south Snohomish County, Kirkland, and Bellevue, which account for another 4 to 8 percent each of the transit market. Within the Seattle transit market, Ballard accounts for approximately 11 percent of the total transit users going to and from the University District in 2035. Ballard and the University District are connected by King County Metro Route 44, which has 10- to 15-minute frequencies all day along NW Market Street and North 45th Street. The largest travel markets for all person trips are also within the city of Seattle and comprise almost two-thirds of all person trips. The next largest concentration of users comes from the cities of Bellevue and Kirkland. Within the Seattle market, many of the trips are destined to Downtown Seattle, First Hill, South Lake Union, and Northgate.

Table 2. Future Year Travel Markets for Trips to and From University District

Major Market by Districts		Transit Trips		Commute Trips		Total Daily Trips	
		Daily Trips	Share	Daily Trips	Share	Daily Trips	Share
North	North Snohomish County	2,640	4%	1,800	2%	2,800	1%
	South Snohomish County	5,420	8%	11,600	13%	13,200	5%
South	Burien	440	1%	1000	1%	1,400	1%
	Tukwila and Renton	940	1%	2400	3%	3,000	1%
	SeaTac and Des Moines	800	1%	1200	1%	1,600	1%
	Federal Way	400	1%	800	1%	1,000	0%
	Kent	880	1%	1400	2%	1,400	1%
East	Far East King County	1,360	2%	3000	3%	3,400	1%
	Redmond (Downtown)	220	0%	200	0%	600	0%
	Redmond (Overlake)	420	1%	200	0%	800	0%
	Issaquah	360	1%	200	0%	400	0%

Table 2. Future Year Travel Markets for Trips to and From University District

Major Market by Districts		Transit Trips		Commute Trips		Total Daily Trips	
		Daily Trips	Share	Daily Trips	Share	Daily Trips	Share
	Kirkland, Bothell, Woodinville, and Kenmore	2,610	4%	2600	3%	3,600	1%
	East Bellevue	2,210	3%	1800	2%	3,600	1%
	West Bellevue and Mercer Island	1,140	2%	2200	2%	4,400	2%
Central	Seattle Central Business District	7,470	11%	10,000	11%	51,800	20%
	Ballard, Fremont, and Wallingford	7,390	11%	11800	13%	34,400	13%
	University Community	4,380	6%	4000	4%	47,000	18%
	Rest of Seattle	27,150	40%	31,600	35%	84,200	32%
Region	Pierce County	1,350	2%	2600	3%	3,600	1%
	Rest of Region	1,040	2%	800	1%	800	0%
Total		68,620	100%	91,200	100%	263,000	100%

4 GOALS AND OBJECTIVES

The HCT system improvements evaluated in each of the corridor studies were developed through a process that first identified corridor issues and needs, refined a problem statement for the study area, and revisited the goals and objectives from Sound Transit's 2005 Long-Range Plan. With this baseline information, alternatives were then developed with the intent to address the corridor issues and needs and achieve Sound Transit's goals to accomplish the following:

- Provide a transportation system that facilitates long-term mobility
- Enhance communities and protect the environment
- Contribute to the region's economic vitality
- Strengthen communities' access to and use of the regional transit network
- Develop a system that is financially feasible

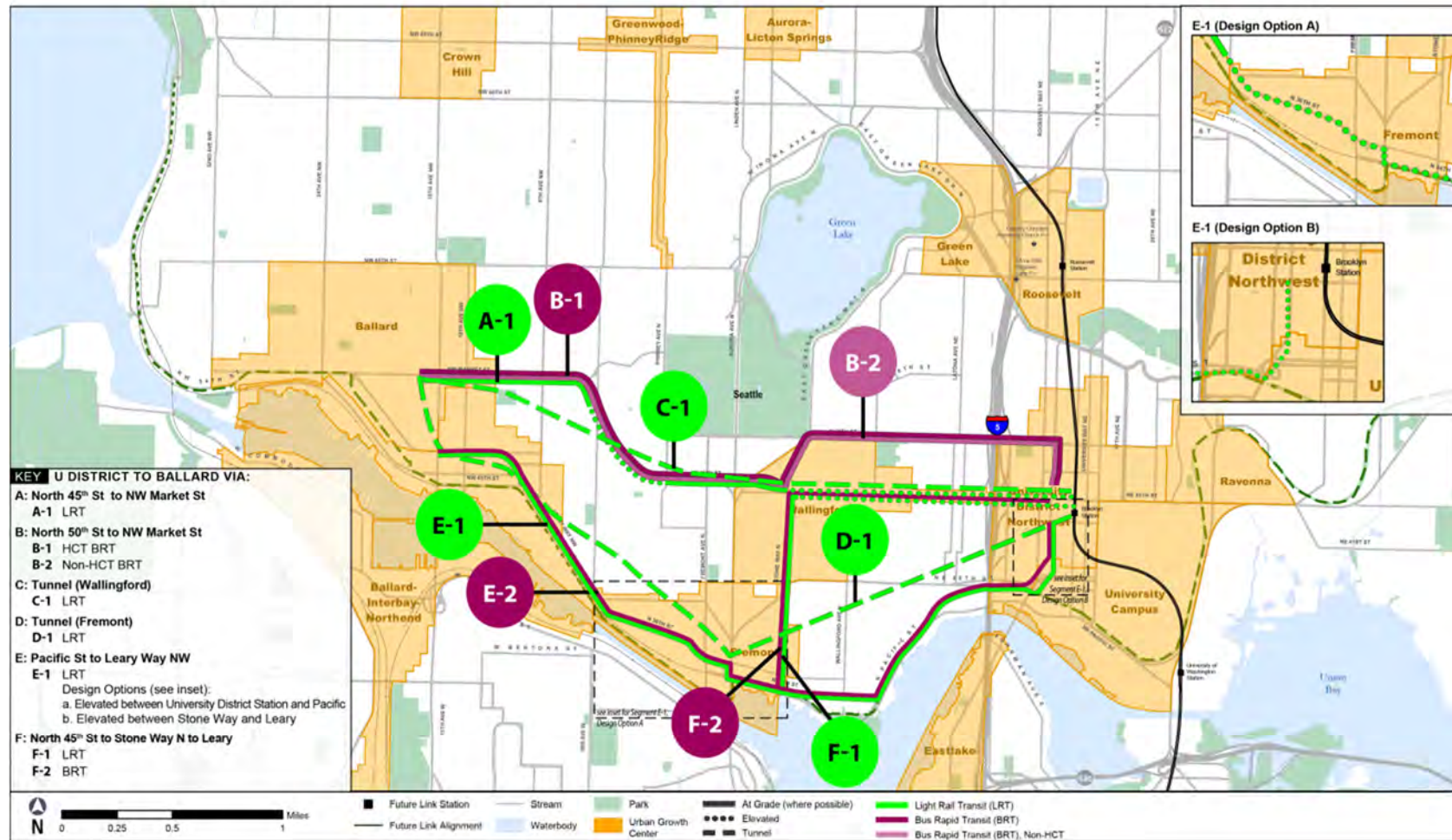
Once the alternatives were developed conceptually, they were evaluated using a three-tiered framework to determine how well they performed against the above stated goals and objectives. The framework consisted of a first tier ("Screening") to advance alternatives that addressed the corridor's identified problem statement, and the second and third tiers (Level 1 Evaluation and Level 2 Evaluation, respectively) further advanced a set of alternatives against the goals and objectives. Key factors of evaluation included aspects of ridership, travel time

savings, costs and cost/benefit factors, transit-oriented development (TOD) potential and environmental effects.

5 INITIAL SCREENING EVALUATION

The range of alternative and mode options for the Ballard to University District corridor screening were identified to address the primary transportation and land use issues and opportunities in the corridor's problem statement. The alternative/mode options identified for evaluation are shown in Exhibit 2. All alternative/mode options would be designed to provide a transfer opportunity at the future University District Link Station. Each concept strove for exclusive or semi-exclusive right-of-way where feasible and included at-grade with elevated and tunnel elements where topographic or other engineering-related constraints existed. Further extensions to the east are possible as part of the University District-Kirkland-Redmond Corridor.

Exhibit 2. Future Year Travel Markets for Trips to and From University District



The initial set of options was then screened based on a review of their performance compared with a set of screening questions (Table 3). The screening questions were developed in response to Sound Transit’s long-range planning goals. If options did not meet the objective of each screening question, it was not forwarded for further evaluation.

Table 3. Goals and Screening Questions

Goals	Screening Questions
Goal 1: Provide a Transportation System that Facilitates Long-Term Mobility	Question 1: Would the concept provide HCT service, defined as “a system of public transportation services within an urbanized region operating principally on exclusive rights of way, and the supporting services and facilities necessary to implement such a system...”?
Goal 2: Enhance Communities and Protect the Environment	Question 2: Could the concept avoid or minimize significant impacts to known designated critically sensitive environmental and/or parks or 4(f) resources where another prudent and feasible alternative has been identified? [NOTE: This would be limited to known parks that are 4(f) and other resources identified by local jurisdictions as highly critical environmental features.]
Goal 3: Contribute to the Region’s Economic Vitality	Question 3: Would the concept connect designated or proposed regional centers, designated urban villages, or other locally- or regionally-identified areas for targeted growth? Question 4: Would the concept serve the region’s employment and residential centers, including areas of future targeted economic growth, as evidenced in adopted local and regional plans?
Goal 4: Strengthen Communities’ Access to and Use of the Regional Transit Network	Question 5: Does the concept connect to existing or planned future Sound Transit HCT service as documented in <i>Sound Transit 2 Plan</i> ? Question 6: Given what is known as of October 2013, is there potential for the concept to be designed so as to avoid: a. Adding trains to the existing downtown transit tunnel b. Adding substantial numbers of new riders to the planned University Link station which could overload the station platforms c. Impacting East Link operations and headways
Goal 5: Develop a System that is Financially Feasible	Question 7: Is it feasible for the concept (mode, corridor) to be constructed to HCT standards, given the known topographic, geometric, and other engineering-related constraints of the corridor and within reasonable costs for expected benefits? Question 8: Could the concept be constructed in a manner so as to avoid substantial regulatory hurdles and/or avoid or mitigate substantial impacts to the natural environment and/or the built environment?

In a workshop format the corridor and mode options being screened were reviewed to identify the alternatives and modes that should be forwarded into the Level 1 Evaluation process. Table 4 summarizes the screening results and identify those alternative/mode options advanced for further evaluation. The alternative names were recategorized for the Level 1 Evaluation. The table below provides both the screening alternative names on the left and the names of the alternatives carried into the Level 1 Evaluation on the right.

Table 4. Screening Results for the Ballard to University District Corridor

Screening Workshop			For Level 1 Evaluation
Screening Alternative (Exhibit 2)	Alternative/ Mode	Advanced for Further Evaluation?	Level 1 Alternative Name
A	N Pacific Street, Leary Way/BRT and LRT	Yes	B2 (LRT)
			B3 (BRT)
B	Elevated Option through U-District/LRT	Yes, combined with Screening Alternative C as a design option to Screening Alternative A in Level 1	B2 Design Option a (LRT)
C	Elevated Option through Fremont/LRT	Yes, combined with Screening Alternative B as a design option to Screening Alternative A in Level 1	B2 Design Option a (LRT)
D	North 45th Street to NW Market/ BRT and LRT	Yes. LRT only was advanced due to street width restrictions on 45th St. A representative BRT Alternative was selected for NE 50th Street where street widths are wider.	A2
E	North 50th Street to NW Market Street /BRT and LRT	Yes. Both HCT BRT (Medium Level BRT) and Non-HCT BRT (Low Level BRT) were advanced. A representative LRT Alternative was advanced for NE 45th Street where street widths are narrower.	A1 A1 Design Option a
F	Elevated on NE 45th Street/LRT	Yes. Advanced as a modification to the main alternative (Screening Alternative D)	A2
G	Elevated on NE 50th Street/LRT	No, Elevated structures were only assumed for LRT in this corridor and as discussed under Screening Alternatives D and E, only BRT was selected along NE 50 th St	Alternative not moved forward into Level 1
H	NE 45th Street or NE 50th Street to Stone Way to North 36th Street to Leary Way NW/BRT	Yes. LRT was also advanced.	C1
			C2

Table 4. Screening Results for the Ballard to University District Corridor

Screening Workshop			For Level 1 Evaluation
Screening Alternative (Exhibit 2)	Alternative/ Mode	Advanced for Further Evaluation?	Level 1 Alternative Name
I	Ravenna, Greenlake, North 85th Street/BRT	No, based on Screening Questions 5 and 7. Although this alternative would connect Ballard with the University District, it would provide a circuitous route that would increase travel time and would also have less of a direct connection to the Ballard to Downtown Alternatives that are being studied.	Not Advanced
J	Connection from Crown Hill to Ballard along 15th Avenue NW	This piece would connect Alternative I to Ballard or connect any of the other alternatives up to Crown Hill. This alternative was not advanced into Level 1 since it did not meet the study's purpose of connecting the University District and Ballard and since Alternative I did not move into the Level 1 Evaluation.	Not Advanced
K	U-District to Fremont to Ballard/LRT tunnel	No, This alternative would connect the U District with the potential Downtown to Ballard tunnel considered in the Downtown to Ballard Study. It was recommended not to assume that the Downtown to Ballard line will be constructed. Therefore this alternative was not continued into It was not advanced into Level 1 since it did not meet the study's purpose of connecting the University District and Ballard.	Not Advanced
L	U-District to Fremont to Ballard/LRT tunnel	Yes	B1
M	U-District, Wallingford to Ballard/LRT tunnel	Yes	A3
N	U-District, Wallingford to Fremont/LRT tunnel	No. Representative tunnel alternatives from Screening Alternatives K and M were ad into Level 1	Not Advanced

6 LEVEL 1 EVALUATION

Sound Transit held a workshop on January 16, 2014, to discuss the results of the Level 1 Evaluation and determine which alternatives would move into the Level 2 Evaluation. The alternatives considered for the Ballard to University District Corridor in this Level 1 Evaluation are shown in Exhibit 3 and are described in more detail below. There are three general market route alternatives for the Ballard to University District Corridor, as follows:

- A Alternatives—University District to Ballard via Wallingford
- B Alternatives—University District to Ballard via Fremont
- C Alternatives—University District to Ballard via Wallingford and Fremont

The modes considered in this corridor are light rail transit (LRT) and bus rapid transit (BRT). The BRT options considered in this evaluation include an alternative where the BRT runs entirely in arterial mixed-traffic (A1a) and several alternatives where the BRT runs in a combination of arterial mixed-traffic and exclusive busway.

The Level 1 Evaluation considered 15 performance measures. The measures, methodologies, and data sources are also listed below:

- Provide a Transportation System that Facilitates Long-Term Mobility
 1. Travel Time
 2. Travel Market Potential
 3. Amount of Exclusive Runningway
- Enhance Communities and Protect the Environment
 1. Effect on Parks and Open Space
 2. Effect on Wetlands
 3. Effect on Existing Transportation Systems
 4. Effect on Right-of-Way/Properties
- Contribute to the Region's Economic Vitality
 1. Access to Activity Centers
 2. Supporting Land Uses
- Strengthen Communities' Access to and Use of the Regional Transit Network
 1. Connectivity to Transit (Bus/Rail) and Multimodal Networks
 2. Disproportionate impacts on Minority or Low-Income Communities
- Develop a System that is Financially Feasible
 1. Conceptual Capital Costs
 2. Potential Utility Conflicts
 3. Construction Challenges
 4. Availability of Land to Construct a Maintenance Facility

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6.1 Level 1 Findings

A summary comparison is provided below for only those performance measures that showed substantial differences between the alternatives.

- **Travel time** is a key differentiator in the Ballard to University District Corridor and, given the congestion levels in the area, variations in travel time are largely a function of the amount of **exclusive right-of-way** provided for each alternative. In general, at-grade alternatives with a lower percentage of exclusive runningways are slower than elevated, tunnel, or at-grade alternatives with more exclusive runningway.
- **Travel market potential** and ridership potential is higher with LRT alternatives than BRT alternatives. Ridership differences are driven largely by differences in travel time, although the alternatives serving all four major corridor markets (University District, Wallingford, Fremont, and Ballard) are likely to show some level of increased ridership over those that serve only three of the four markets. Alternatives A3, B1, B2 (including Design Option B2a), and C1 performed best against this measure.
- **Effects on parks and open space** were higher with at-grade and elevated alternatives that operated along North 45th Street or North 50th Street through the Wallingford neighborhood. **Impacts on right-of-way/properties** vary depending on the extent of roadway widening required to accommodate exclusive runningways. The surface-running LRT alternatives (both at grade and elevated) have the highest impacts, followed by the BRT alternatives with a higher percentage of exclusive busway. The LRT tunnel alternatives and BRT alternative running entirely in arterial mixed-traffic have much lower levels of right-of-way impact.
- **Effects on existing transportation systems:** The LRT alternatives, assumed that existing transportation functionality would be preserved by “replacing in kind” both travel lanes and displaced parking. However, the BRT alternatives assumed a lower level of travel lane and parking replacement for the BRT sections of exclusive busways. Therefore, those BRT alternatives with more exclusive busways showed higher effects on existing transportation systems than the surface LRT alternatives. Alternatives A3 and B1 performed best against this goal.
- **Capital costs** were conceptual and varied substantially. Two main factors were considered: potential construction costs and right-of-way acquisition. LRT alternatives generally had higher construction costs than BRT alternatives; tunnels are most expensive to construct, followed by elevated guideway. Possible right-of-way acquisition is a substantial cost driver for the surface alternatives with exclusive right-of-way, but a much smaller factor in tunnel alternative costs.
- **Construction challenges** vary among alternatives, with elevated LRT showing the highest levels of construction challenge, followed by the tunnel LRT and BRT exclusive busway alternatives. The BRT in arterial mixed-traffic shows a low level of construction

challenge. Alternatives A1 (including Design Option A1a), B3, and C2 performed best against this goal.

6.2 Alternatives Selected for Level 2 Evaluation

The following representative alternatives were forwarded into the Level 2 Evaluation. Each alternative can be refined after further analysis.

- Alternative A1: BRT in a Combination of Arterial Mixed-Traffic along North 50th Street
- Alternative A3: LRT via Wallingford Tunnel
- Alternative B2: LRT via North Pacific Street and Leary Way NW
 - Alternative B2, Design Option a: LRT with Elevated Segments through University District and Fremont
- Alternative B3: BRT in a Combination of Arterial Mixed-Traffic and Exclusive Busway along North Pacific Street/Leary Way NW
- Alternative C1: LRT via North 45th Street/Stone Way North/Leary Way NW

7 LEVEL 2 EVALUATION

The Level 2 Evaluation considered 19 performance measures intended to supplement the analysis already conducted in the Level 1 Evaluation. Some of these measures were carried forward from Level 1 Evaluation for refinements (for example, travel time, ridership and cost), while others were new, as will be explained below.

The Level 2 measures are listed below, organized by Sound Transit Long-Range Plan Update goal:

- Provide a Transportation System that Facilitates Long-Term Mobility
 1. Travel time
 2. Ridership
- Enhance Communities and Protect the Environment
 1. Potential for effects on streams
 2. Potential for vibration effects
 3. Potential for noise effects
 4. Potential for visual effects
 5. Potential effects on traffic operation
 6. Potential access and parking effects
- Contribute to the Region's Economic Vitality
 1. Development potential
 2. Access to transit-oriented development (TOD)

3. Potential effect on right-of-way/properties
- Strengthen Communities' Access to and Use of the Regional Transit Network
 1. Connectivity to regional and local transit (bus/rail) networks
 2. Ability to connect to the transit network
- Develop a System that is Financially Feasible
 1. Capital costs
 2. Operations and maintenance costs
 3. Construction challenges
 4. Potential conflicts with major utilities
 5. Cost effectiveness
 6. Availability of land to construct a maintenance facility

The key findings of the Level 2 Evaluation are presented in Section 7.2.

7.1 Description of Alternatives

The Level 2 Evaluation alternatives considered for the Ballard to University District Corridor are described in this section and shown on Exhibit 4. The modes considered in this corridor are LRT and BRT. For BRT, combinations of exclusive busway, freeway express toll lanes/managed lanes, and arterial mixed traffic are also considered for various alternatives. All LRT alternatives assume two-car trains and stations.

With one exception, the Ballard to University District Corridor HCT alternatives assume that all transportation functions (travel lanes, turning lanes, parking, and sidewalks) are replaced in kind, and alternative footprints assume the acquisition of sufficient right-of-way to keep these functions intact.

The exception to the “replace-in-kind” assumption is Alternative C1, LRT via North 45th Street/Stone Way/Leary Way NW. For the section along North 45th Street between the University District and Stone Way, this Level 2 Evaluation assumes the minimum right-of-way impacts possible to accommodate elevated LRT while minimizing impacts on the adjacent properties. The resulting street configuration makes room for the elevated LRT footprint by narrowing sidewalks and reducing the street width to 20 feet in each direction; that 20 feet could be used for through travel lanes, left turn lanes, and/or parking, but it cannot accommodate all three as they exist today. For this evaluation, Alternative C1 assumes one 12-foot travel lane and 8 feet for parking, but left turn pockets are eliminated along North 45th Street.

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All Ballard to University District Corridor LRT alternatives include a potential representative station near the underground North Link U-District Station currently under construction and a station near 15th Avenue NW and NW Market Street in Ballard. The Ballard to University District Corridor does not assume sharing a station with North Link, but rather constructs new track and a new station as close to the North Link's U-District Station as possible to efficiently facilitate transfers between the two lines with additional vertical access design concepts. No park-and-ride facilities are assumed in this corridor.

In general, changes made between the Level 1 and Level 2 Evaluations were refinements, to reflect a higher level of detail and knowledge of corridor conditions. Adjustments were made to track geometry and representative station area locations to avoid known effects and minimize possible property acquisitions.

7.2 A Alternatives – Serving Wallingford

7.2.1 Alternative A1: BRT in a Combination of Arterial Mixed-Traffic and Exclusive Busway along North 50th Street

Alternative A1 is a combination of mixed-traffic and exclusive busway BRT connecting the University District with Ballard via Wallingford. It begins at the U-District Station on North 45th Street and heads north in mixed-traffic to 50th Street and then west, still in mixed-traffic, to Greenlake Way. The BRT then transitions to exclusive bus lanes along Greenlake Way at Stone Way, continues along North 46th Street and then along NW Market Street to 15th Avenue NW. The Level 2 Evaluation assumes 51 percent exclusive runningway for this alternative.

BRT stops for evaluation purposes were assumed at North 45th Street/Brooklyn Avenue NE; North 45th Street/Stone Way; and NW Market Street/15th Avenue NW.

7.2.2 Alternative A3: LRT via Wallingford Tunnel

Alternative A3 is a light rail tunnel connecting the University District and Ballard via Wallingford. At this level of evaluation, the alternative is representative; actual tunnel location could vary based on soil and tunneling conditions identified by additional design work in the future. LRT tunnels are assumed to be twin-bore tunnels 19 feet in diameter, similar to North Link tunnels. Alternative A3 assumes potential LRT cut-and-cover stations near North 45th Street/Brooklyn Avenue, North 45th Street/Stone Way, and NW Market Street/15th Avenue NW.

7.3 B Alternatives – Serving Fremont

7.3.1 Alternative B2: LRT via North Pacific Street and Leary Way NW

Alternative B2 is an entirely at-grade LRT alternative. It runs in the University District along 15th Avenue NE and NE Pacific Street, connecting with Fremont via North Pacific Street and North 34th Street. From Fremont, the alternative continues west along Fremont Place North, North 36th Street, and Leary Way NW to 15th Avenue NW, north to NW Market Street in Ballard.

At-grade LRT stations for evaluation purposes were assumed at 15th Avenue NE/North 44th Street; Fremont Avenue/North 36th Street; Leary Way NW/8th Avenue NW; and 15th Avenue NW/NW Market Street.

7.3.2 Alternative B2a: LRT with Elevated Segments through University District and Fremont

Design Option B2a follows the same route as Alternative B2, except it elevates the guideway in three sections to improve efficiency and minimize effects:

- Elevated along 15th Avenue NE south to NE Pacific Street in University District
- Elevated along Fremont Place North and North 36th Street to Leary Way NW in Fremont
- Elevated along NW Leary Way at 11th Avenue NW and then along 15th Avenue NW to NW Market Street in Ballard

LRT stations were assumed to be similar to those in Alternative B2 except that the U-District Station on 15th Avenue NE, the station in Fremont on North 36th Street, and the station in Ballard on 15th Avenue NW were assumed to be elevated stations.

7.3.3 Alternative B3: BRT in a Combination of Arterial Mixed-Traffic and Exclusive Busway along North Pacific Street/Leary Way NW

This BRT alternative connects the University District and Ballard via Fremont, operating at-grade along a similar route to Alternative B2. Exclusive runningways are provided for 53 percent of the corridor in the following locations:

- **University District**—along NE Pacific Street/NE Northlake Way from 15th Avenue NE to 6th Avenue NE and then along North Pacific Street from 6th Avenue NE to North 35th Street
- **Ballard**—along Leary Way NW and 15th Avenue NW between North 36th Street and NW Market Street

The remainder of the alternative would operate in mixed-traffic and assumes using Transportation System Management-(TSM) strategies such as signal timing optimization to improve travel time reliability. TSM strategies seek to enhance the capacity of an existing system through improvements that are operational in nature. For evaluation purposes, BRT stops were assumed at NE 45th Street/University Drive (next to North Link Station); North 35th Street/Fremont Place North; Leary Way NW/8th Avenue NW and 15th Avenue NW/ NW Market Street.

7.4 C Alternatives—Serving Wallingford and Fremont

7.4.1 Alternative C1: LRT via North 45th Street/Stone Way North/Leary Way NW




















Alternative C1 connects the University District and Ballard via *both* Wallingford and Fremont. It consists of LRT on an elevated guideway along North 45th Street between the University of Washington/15th Avenue NE and Stone Way North. The alternative transitions to at-grade on Stone Way to North 34th Street into Fremont, continuing at-grade to Ballard via North 36th Street, Leary Way NW, and 15th Avenue NW.

For evaluation purposes, LRT stations were assumed near NE 45th Street/15th Avenue NE (elevated); North 45th Street/Stone Way (elevated); Fremont Avenue North/North 34th Street (at-grade); Leary Way NW/8th Avenue NW (at-grade); and 15th Avenue NW/NW Market Street (at-grade).

7.5 Key Findings by Performance Measure

The key findings of the Level 2 Evaluation are provided below and summarized in Exhibit 5; more detailed information is available in the *Ballard to University District Corridor Level 2 Evaluation Report* (Sound Transit, 2014b). The key findings pertain to only those performance measures that showed substantial differences between the alternatives.

Exhibit 5. Level 2 Evaluation Results

		 Lower Performing → Higher Performing		 U District - Wallingford - Ballard		 U District - Fremont - Ballard		 U District - Wallingford - Fremont - Ballard	
GOAL	PERFORMANCE MEASURES								
Provide a transportation system that facilitates long-term mobility	 Travel Market Potential	 BRT in a combination of mixed traffic and exclusive busway along N 50th St	 LRT via Wallingford tunnel	 LRT via N Pacific St and Leary Wy NW	 LRT with elevated segments through University District and Fremont	 BRT in mixed traffic and exclusive busway along N Pacific St and Leary Wy NW	 LRT via N 45th St, Stone Wy N, and Leary Wy NW		
	 Reliability	18 to 22 minutes 14k to 17k riders per day	6 to 9 minutes 22k to 26k riders per day	10 to 13 minutes 20k to 24k riders per day	10 to 12 minutes 21k to 26k riders per day	14 to 19 minutes 10k to 12k riders per day	9 to 11 minutes 23k to 28k riders per day		
Enhance communities and protect the environment	 Environmental Effects								
	 Existing Transportation System								
Contribute to the region's economic viability	 Development Potential								
Strengthen communities' access to and use of the regional transit network	 Regional Connectivity								
Develop a system that is financially feasible	 Preliminary Design Cost Estimate	\$159 mil - \$206 mil	\$1,396 mil - \$1,879 mil	\$1,215 mil - \$1,641 mil	\$1,163 mil - \$1,572 mil	\$286 mil - \$387 mil	\$1,238 mil - \$1,672 mil		
	 Complexity								
	 Cost Effectiveness								

7.5.1 Travel Time

Travel time is a key differentiator in the Ballard to University District Corridor, and given the congestion levels in the area, variations in travel time are largely a function of the **amount of exclusive runningway** provided for each alternative. The LRT tunnel alternative (Alternative A3) performs best against these criteria, followed by the surface LRT alternatives (Alternatives B2, B2a, and C1). The BRT alternatives, which run partially in mixed-traffic, are less reliable and lower performing.

7.5.2 Ridership

Ridership differences are driven largely by differences in travel time. With the highest degree of separation from congested traffic conditions, the LRT alternatives perform best. Ridership is highest on Alternative C1 (elevated LRT on North 45th Street/Stone Way North/Leary Way NW), with 23,000 to 28,000 riders per day, however project ridership on Alternative A3 (LRT via Wallingford tunnel) is very close at 22,000 to 26,000 riders per day. The distinction between these two alternatives is likely due to the fact that Alternative C1 serves four markets (University District, Wallingford, Fremont, and Ballard), while Alternative A3 serves only three markets (University District, Wallingford, and Ballard). The other LRT alternatives (Alternatives B2 and B2a) follow closely, with daily ridership ranging from 20,000 to 26,000 riders per day. BRT ridership is about half that of LRT, with Alternatives B3 and A1 showing 10,000 to 12,000 daily riders and 14,000 to 17,000 daily riders, respectively.

7.5.3 Natural Environment

Potential effects on parks and open space were differentiators: the LRT tunnel alternative (Alternative A3) scores highest with no effects; LRT on North 45th Street could potentially effect one park and the Burke Gilman Trail; and all other alternatives score lower due to potential effects on four to six parks and the Burke Gilman Trail.

Given the dense, urbanized nature of the corridor, none of the alternatives are rated highest-performing with respect to **land uses sensitive to noise and vibration**. The tunnel alternative (Alternative A3) and LRT via North Pacific Street/Leary Way (Alternatives B2 and B2a) show lower levels of potential effect than the others due to their locations (underground and along a more industrial/commercial corridor, respectively). BRT along North Pacific Street/Leary Way (Alternative B3) follows a slightly different alternative than the LRT options (Alternatives B2 and B2a), potentially affecting a large number of single-family and multifamily properties. Elevated LRT on North 45th Street potentially affects many adjacent properties given the constrained right-of-way, and BRT on North 50th street receives the lowest-performing rating because it travels through largely single-family residential neighborhoods. This is potentially an impact for noise and vibration due to the close proximity of elevated LRT to single-family homes in this constrained environment.

Similar analysis applies to **land uses sensitive to visual effects**. The tunnel alternative has the lowest potential visual effect, followed by LRT on Pacific Street/Leary Way. LRT on North 45th

and BRT on North 50th show the most potential effects for similar reasons to those described in the discussion about noise/vibration (above).

7.5.4 Built Environment

The **potential effects on access and parking** measure expands on the **potential effect on existing transportation systems** measure from the Level 1 Evaluation. For this Level 2 Evaluation, where exclusive runningway displaces roadway functions, all of those functions (including through lanes, turning lanes, parking, and sidewalks) are assumed to be replaced in kind *except* in Alternative C1 along North 45th Street. In the case of Alternative C1, elevated LRT leaves 20 feet of roadway on each side of the guideway, which has been assumed for purposes of this evaluation to accommodate a 12-foot travel lane and an 8-foot parking lane. As a result, parking removal is not a distinguishing factor among the alternatives, since it is either not affected (by the LRT tunnel in Alternative A1), preserved (on North 45th Street in Alternative C1), or replaced (everywhere else in the study area). Other transportation functions show more variation, however. The LRT tunnel (Alternative A3) and BRT on North 50th Street (Alternative A1) perform best, with the fewest potential effects. LRT via North Pacific Street/Leary Way (Alternatives B2 and B2a) and LRT along North 45th Street (Alternative C1) are rated lower, creating right in/right out only access restrictions in some locations.

The **effects on right-of-way/properties** measure is a major differentiator among corridors for the Level 2 Evaluation. The dense, urban development and narrow roadways that characterize the Ballard to University District Corridor make it very difficult, and complex, to fit in exclusive HCT guideways without acquiring additional right-of-way to replace transportation functions in kind. The result is that only the tunnel alternative (Alternative A3) performs well against this measure. All other alternatives necessitate a much larger number of property acquisitions to accommodate HCT and replaced-in-kind transportation functions. The greatest potential effect is observed under Alternative C1 LRT via North 45th Street/Stone Way North/Leary Way NW, with substantial acquisitions required. This is due in part to the large number of properties affected along North 45th Street. However, as evidenced by the fact that LRT via North Pacific Street/Leary Way has the second-greatest potential effect, the stretch of at-grade LRT along North Pacific and Leary Way NW also has the potential to affect a large number of properties.

7.5.5 Station Area Assessment

If the Ballard to University District Corridor is identified for future HCT development, Sound Transit would work with local communities and coordinate with any applicable stakeholders for Ballard to Downtown station area planning efforts to determine appropriate station locations. The station area assessment work provides a discussion of potential representative station areas considered in the Level 2 Evaluation for comparative and informational purposes.

The Ballard to University District Corridor contains a total of six potential representative station areas that were assessed as part of the Level 2 Evaluation, all of which are located in the city of Seattle. The representative station areas along the Ballard to University District Corridor generally do not feature a very high development potential or access to TOD. This is due to the

highly developed nature of the Ballard to University District Corridor and the presence of large areas of established single-family residential, which were not assumed to be conducive to redevelopment. Overall, the representative station areas in Fremont, Wallingford, and West Woodland provide the greatest contrast in TOD and development potential among corridor alternatives, because all are assumed to serve the University District and Ballard.

The representative station area in the University District near NE 45th Street and 15th Avenue NE would be designed to connect to the U-District Link station currently under construction. The representative station area is located in a well-developed urban center and is adjacent to the UW campus, which limits development potential. However, there are some redevelopment opportunities in the core commercial areas along University Way NE and NE 45th Street where zoning permits mixed-use, higher-density development.

Two potential representative station area locations are located in the Wallingford neighborhood. The first location is assumed for evaluation purposes to be in the vicinity of Stone Way North and North 50th Street, while the second location is assumed for evaluation purposes to be near Stone Way North and North 45th Street. In general, the character of the Wallingford urban village is smaller scale than other representative station areas along the BUD Corridor, which could limit overall development potential. The representative station area near North 45th Street performs slightly better than the North 50th Street because it is closer to the Wallingford commercial district and, because it is located further away from Woodland Park, has more land available for redevelopment within the transit walkshed. There are no substantial differences in the TOD and development potential between the Wallingford representative station areas to be reflected in evaluation scores.

The representative station area in Fremont, near Fremont Avenue North and North 36th Street, is located in a locally designated urban center receives a moderate assessment for both representative station area evaluation criteria. In addition to the general station area characteristics described above, the Lake Washington Ship Canal forms an obstacle within the transit walkshed at Fremont, limiting development potential and station access from the south.

The representative station area in West Woodland, near Leary Way NW and 8th Avenue NW, is the only station area along the Ballard to University District Corridor that is not located in an urban center or village. This representative station area has very little zoning that is conducive for TOD. However, the presence of industry along the waterfront could provide opportunities for redevelopment in the future if land use policy changes were to be made.

The representative station area in Ballard is located in the Ballard urban village near 15th Avenue NW and NW Market Street. The station area, while located several blocks to the east of the core commercial area in Ballard where development potential is assumed to be greatest, generally exhibits moderate potential for growth in areas that allow for TOD or that are currently occupied by large-lot industrial or commercial uses.

7.5.6 Transit Access

All measures within this goal showed very little variation among alternatives. **Connectivity to transit** (both existing and proposed future systems) is strong for all alternatives. As reported in the Level 1 Evaluation, there is little variation among **supporting land uses** (defined within the transit access criterion as the total population and employment within a representative station area), and all of the alternatives provide consistent **access for minority or low-income communities**.

7.5.7 Capital Costs and Construction Challenges

Capital costs vary substantially across alternatives and result from two main factors: construction costs and potential right-of-way acquisition. LRT construction costs are estimated to be higher than BRT costs; tunnels are most expensive to construct, followed by elevated guideway. Right-of-way acquisition increases the cost of surface LRT alternatives by 50 to 100 percent, making the overall capital cost for those alternatives comparable with LRT tunnel costs. Right-of-way costs also increase the cost for BRT alternatives, comprising about 30 percent of BRT costs on North 50th Street and almost 70 percent of BRT costs on North Pacific Street/Leary Way NW. In general, order-of-magnitude estimates for the LRT alternatives are estimated at approximately five times the cost of the BRT alternatives. **Operations and maintenance costs** range from \$8.8 million to \$12.5 million per year, with BRT alternatives at the higher end of the spectrum, the LRT tunnel alternative in the middle, and the surface LRT alternatives at the lower end of the range.

None of the alternatives exhibit infeasible **potential conflicts with known major utilities**, although a large sewer vault in the University District presents a station location and connection challenge for the LRT tunnel alternative. The LRT tunnel and BRT alternatives observed no identified major effects; potential transmission line conflicts may exist with LRT alternatives on Pacific Street/Leary Way (Alternatives B2, B2a, and C1). In addition, LRT on North 45th Street (Alternative C1) would need to accommodate a large stormwater line near North 45th Street. **Construction challenges** vary among alternatives, with the surface LRT alternatives performing somewhat lower than the tunnel LRT and BRT alternatives due to potential effects on traffic and access, the Burke Gilman Trail and the University of Washington, and construction of elevated guideway (Alternatives B2a and C1). Complexities associated with tunneling in an urban environment are anticipated for the tunnel alternative (Alternative A3). Finally, **availability of land and ease of access to a new maintenance facility** considered possible within the alternatives in this corridor, as there are potential sites available in the Ballard-Interbay manufacturing and industrial center.

The main issue areas for the BUD Corridor include the developed nature of the corridor and the lack of existing east/west right of way available to convert to HCT use.

8 RISKS AND UNKNOWNNS

The analysis in this Level 2 Evaluation is built on very early design concepts and planning-level estimates. Findings are based on design assumptions that cannot be confirmed until a higher level of design is completed. Further, some of the assumptions are based on factors that are impossible to predict at this point or are beyond Sound Transit's control. Construction challenges and additional risks that have been identified and will be further studied if and when a potential HCT project in the Ballard to University District Corridor moves forward.

9 CONCLUSION

The information provided in this report will be used to inform Sound Transit's long-range plan update and if appropriate, the development of the next voter funding proposal. This information would be useful as well if funding is identified to move it into project development, as a basis for a future alternatives evaluation or conceptual design phase.

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